COMPUTATIONAL MODELING OF CULTURAL DIMENSIONS IN ADVERSARY ORGANIZATION

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Outline

- A Multi-Disciplinary Research Team
- Objectives
- Approach
- Two Models
  - Organization Model
  - Influence Net Model
- Summary

A Multi-Disciplinary Research Team

- **George Mason University**
  - **Prof. Alexander H. Levis, PI**
    System Architectures Laboratory (SAL)
    School of Information Technology and Engineering

  - **Prof. Claudio Cioffi-Revilla, Co-PI**
    Center for Social Complexity (CSC)
    Krasnow Institute for Advanced Study

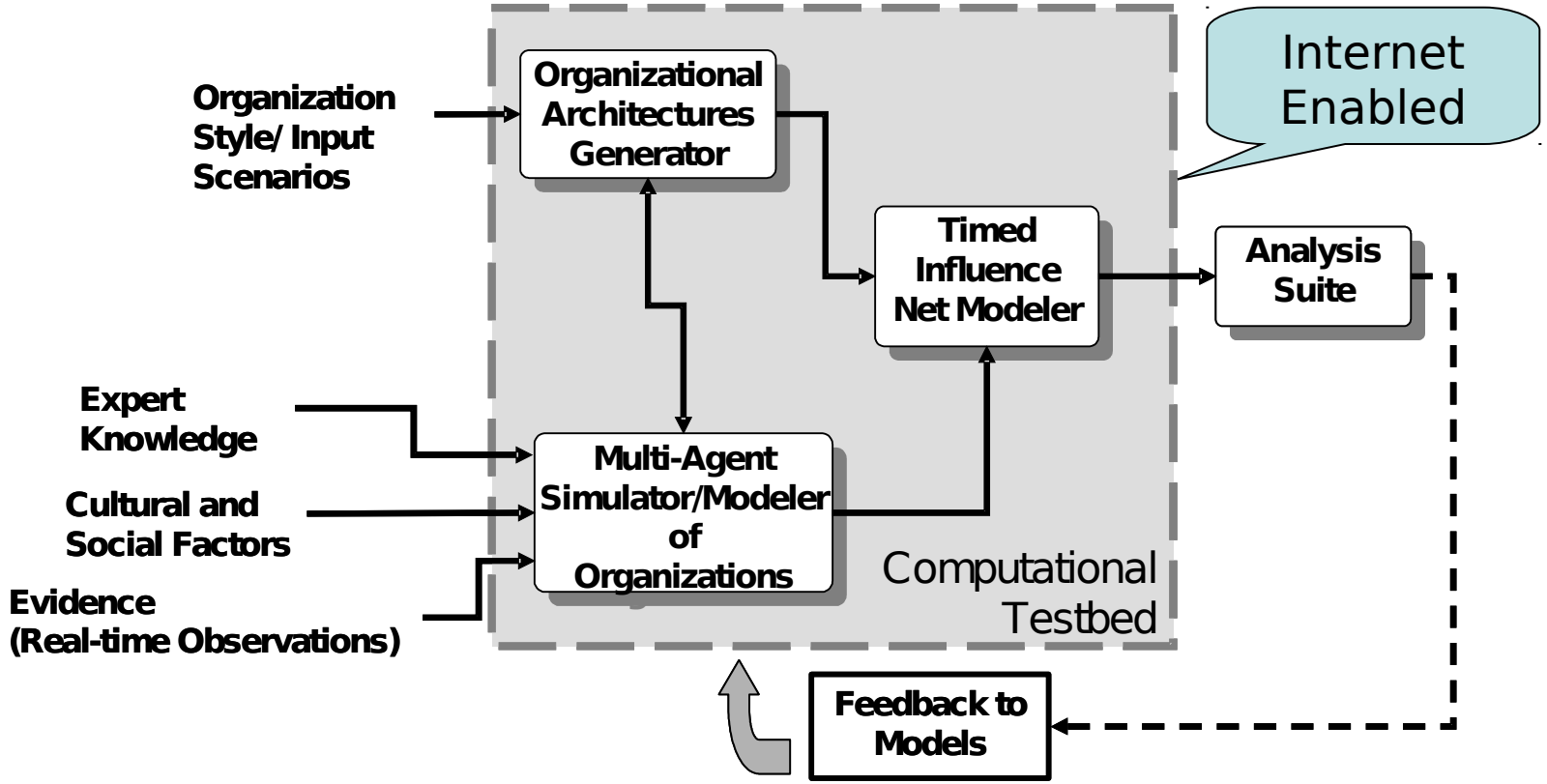
- **Carnegie Mellon University**
  - **Prof. Kathleen M. Carley, Co-PI**
    Center for Computational Analysis
    for Social and Organizational Systems (CASOS)
    Institute for Software Research International

Objectives

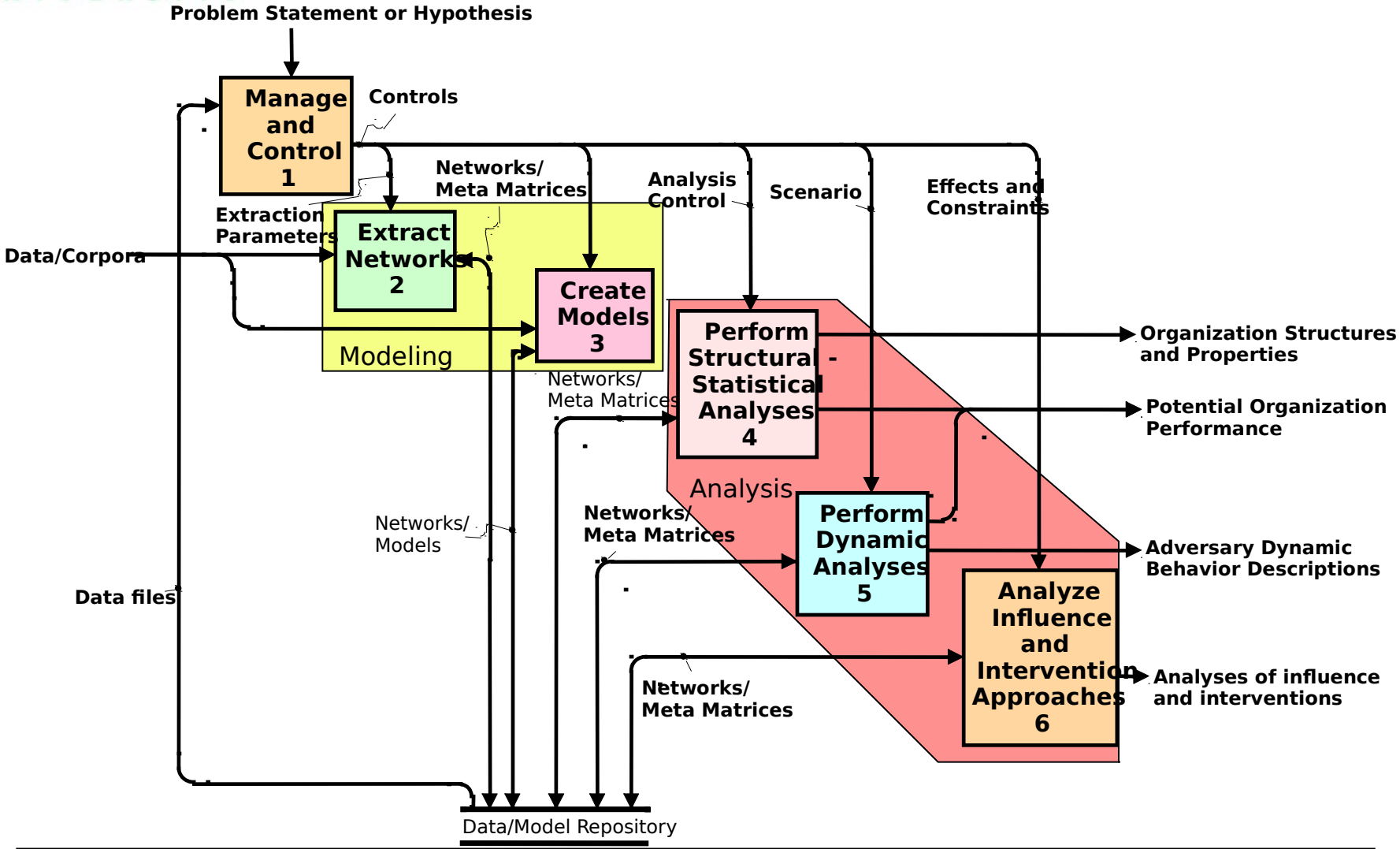
- ***To relate an adversary's organizational structure to behavior when both structure and behavior are conditioned by cultural and social characteristics,***
- ***To address basic research questions centered on locating the points of influence and characterizing the processes necessary to influence organizations in diverse cultures.***
- ***To explore, through a computational modeling framework, the nexus between data and models for individual adversaries (micro level) and data and models for organizations of adversaries (macro level).***

Approach

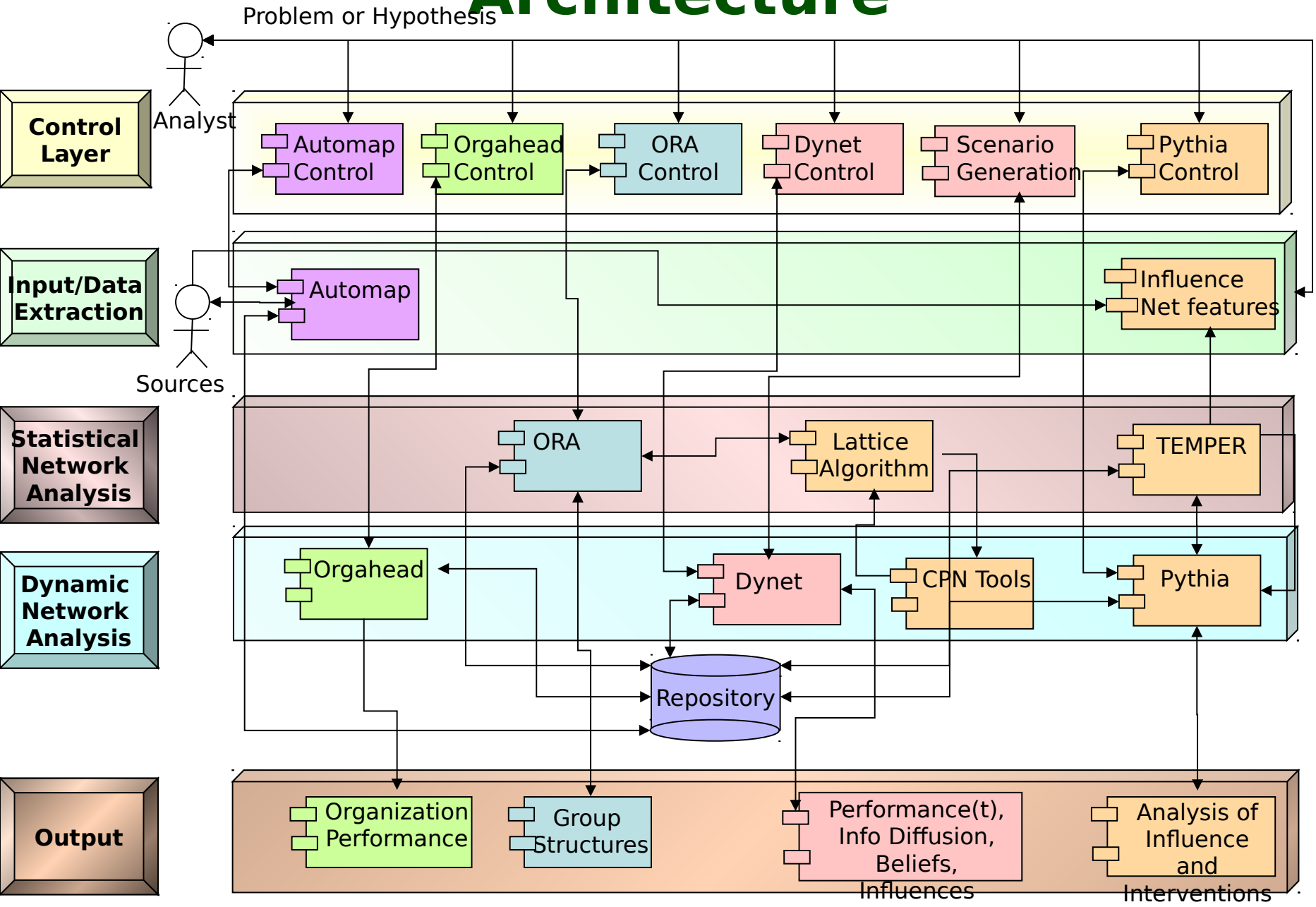
- **Implement a distributed computational testbed consisting of a set of models and tools developed independently by the three collaborating research centers.**



Operational View (Major Activities)

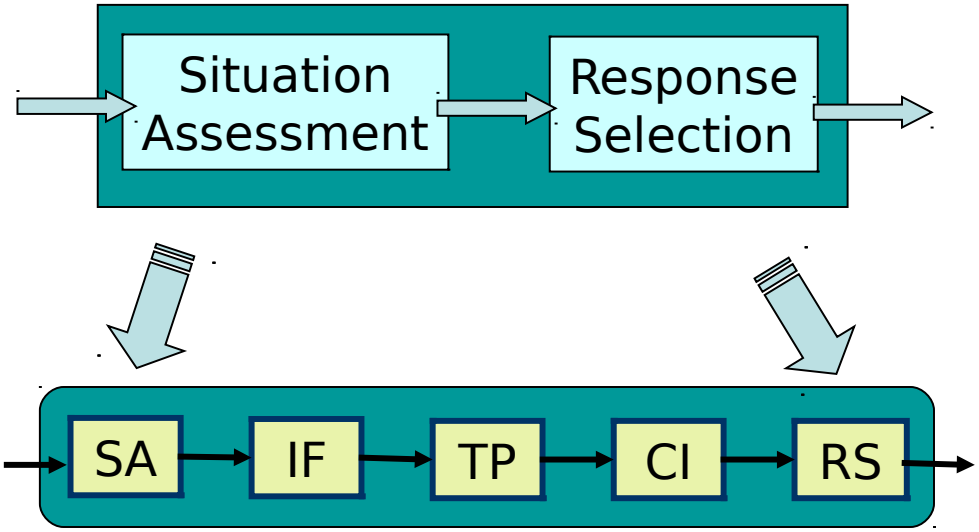


System View, a Layered Architecture



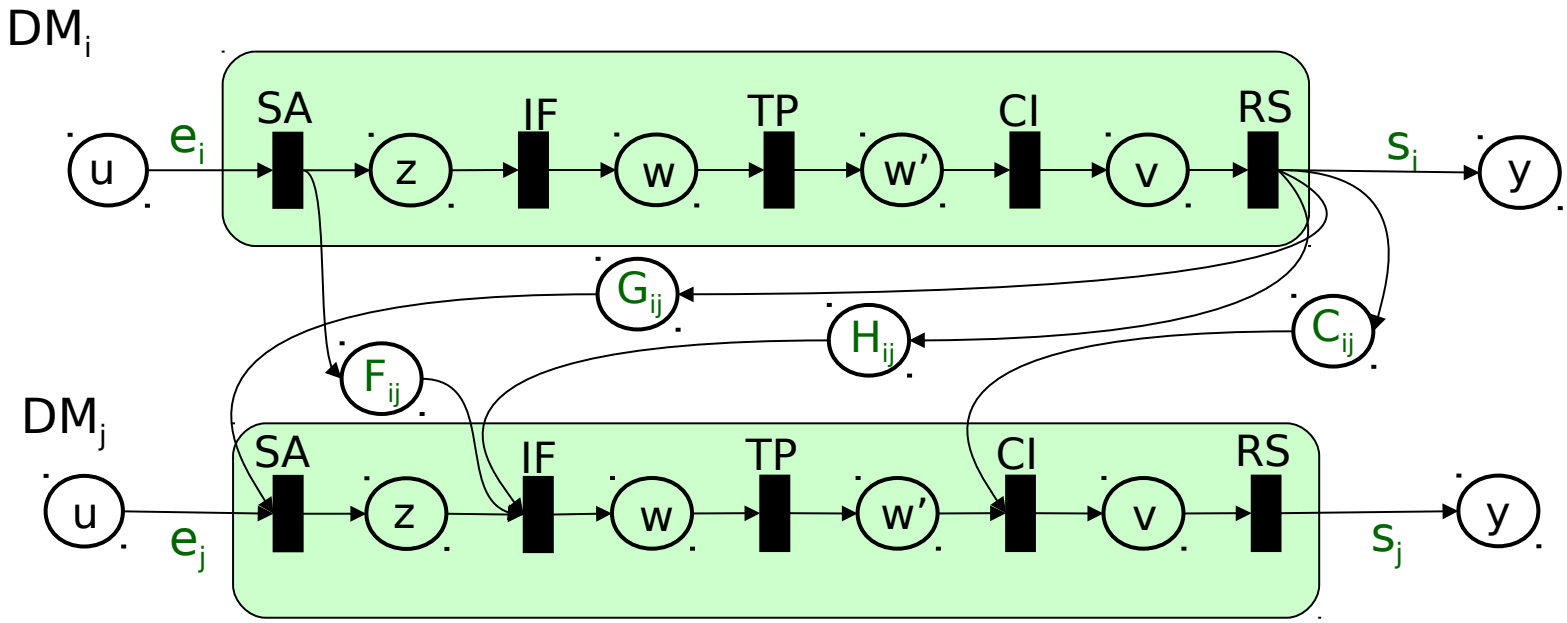
The DM Model

- **A five stage model of the interacting decision maker was postulated as an extension of the stimulus – response model:**



IF: Information Fusion
TP: Task Processing
CI: Command Interpretation

Interactions



- **The figure represents interactions from DM_i to DM_j. The symmetric interactions exist from DM_j to DM_i.**

Current Effort

- **Hofstede's Cultural Dimensions are being used to establish additional constraints on the interactions among decision makers in a culturally homogeneous organization**
- **Independent Variables:**
  - **National Culture: Power distance, individualism, masculinity, uncertainty avoidance.**
  - **Interaction Densities: Information sharing (dF) density, control density (dG), result sharing density (dH), command density (dC).**
- **The four Cultural Dimensions are reflected in the design problem by constraining the interaction densities**
- **Preliminary results show that such constraints identify different subsets of the culturally unconstrained lattice of organizational structures**
- **Next steps:**
  - **Evaluate performance in terms of accuracy and timeliness**
  - **Consider interacting culturally different organizations**

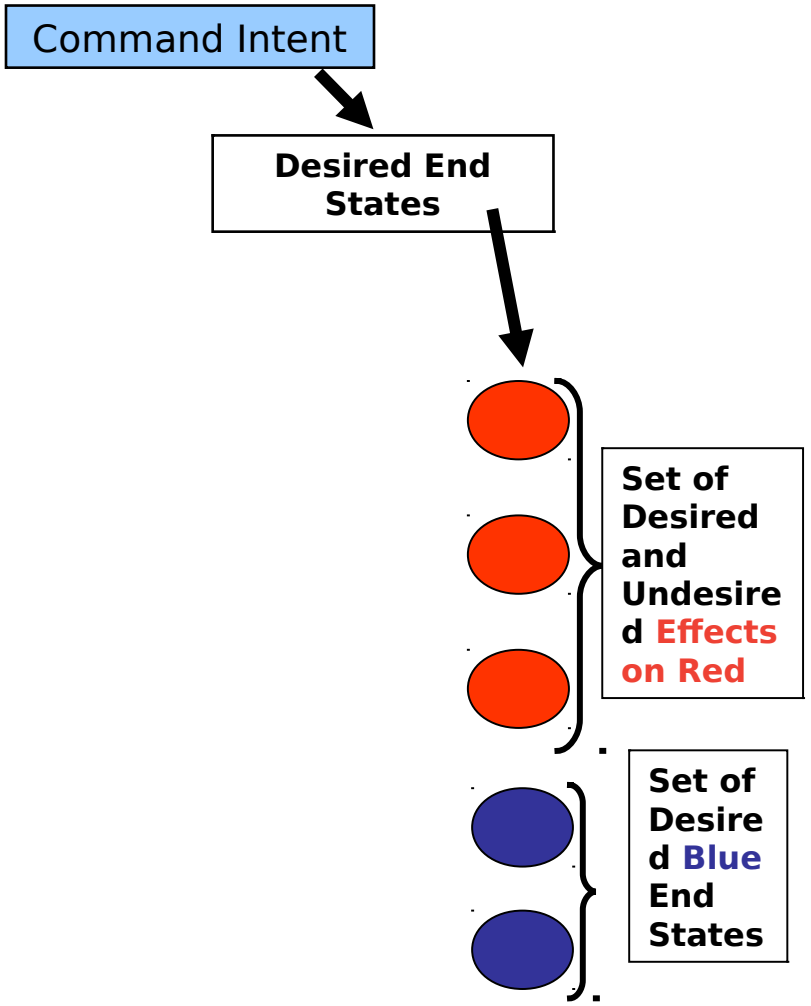
Effects based Operations

- **An effects based way of thinking has been evolving for some time. Objectives can be obtained by achieving effects. Effects can be achieved by actions that comprise Courses of Action**
- **The Effects-based Operations focus requires in depth understanding of the adversary**
  - **Adversarial Modeling**
- **Issues:**
  - **The mechanistic computational models we have are not well suited to these challenges – but the purely social science ones don't address the problems either**
  - **Multiple time scales: Components of DIME yield observables on different time scales making assessment a real challenge**
  - **Scenarios are very complex with rapid migration of control**
  - **Organizations are large - not amenable to scientific experiments (not enough repetitions possible)**

Influence Nets

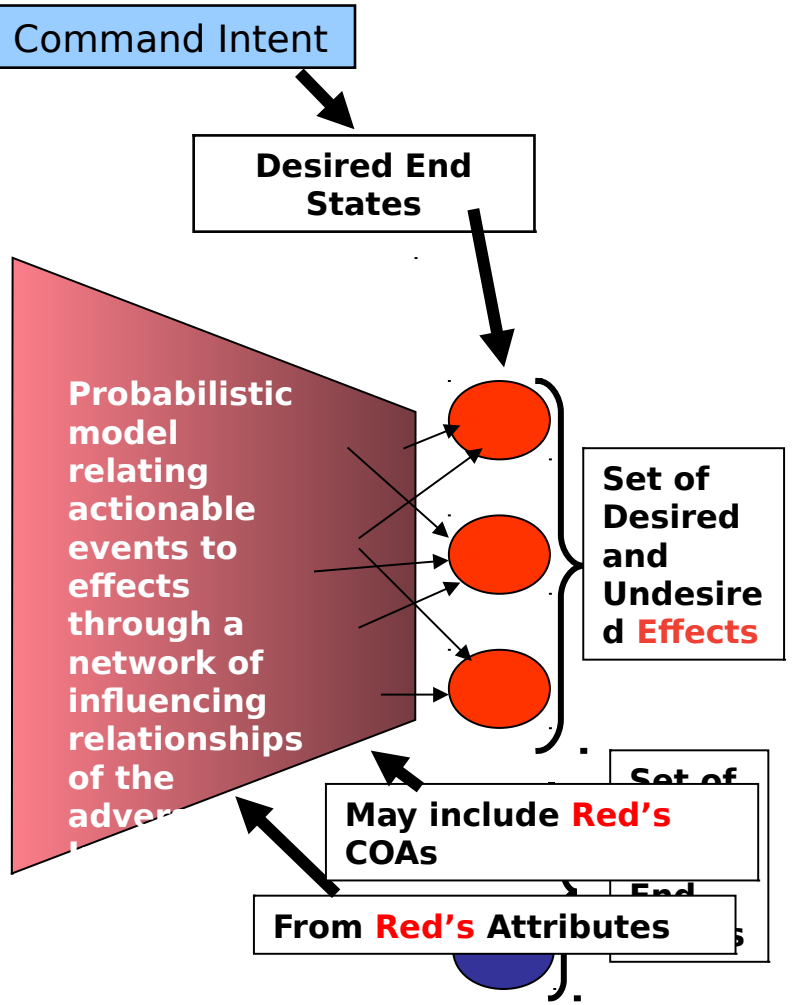
- **An approach that tries to explain how actions can achieve effects gave rise (1994) to Influence net modeling, a variant of Bayesian nets. SAIC, supported by GMU, developed SIAM (Situational Influence Analysis Model) for DARPA & CIA; this has been used extensively by the Intelligence community as well as others**
- **SIAM enables the representation of influences (causes) that impact the achievement of a desired effect. By stimulating selected independent influences, one tries to maximize the probability of achieving the effect**
- **The R&D community has since evolved the approach into a *dynamic model* that includes temporal aspects resulting in probability profiles**
  - **Research implementation: GMU's Pythia**
  - **Operational implementation: AFRL/IF's JCAT**

Effects Based Modeling

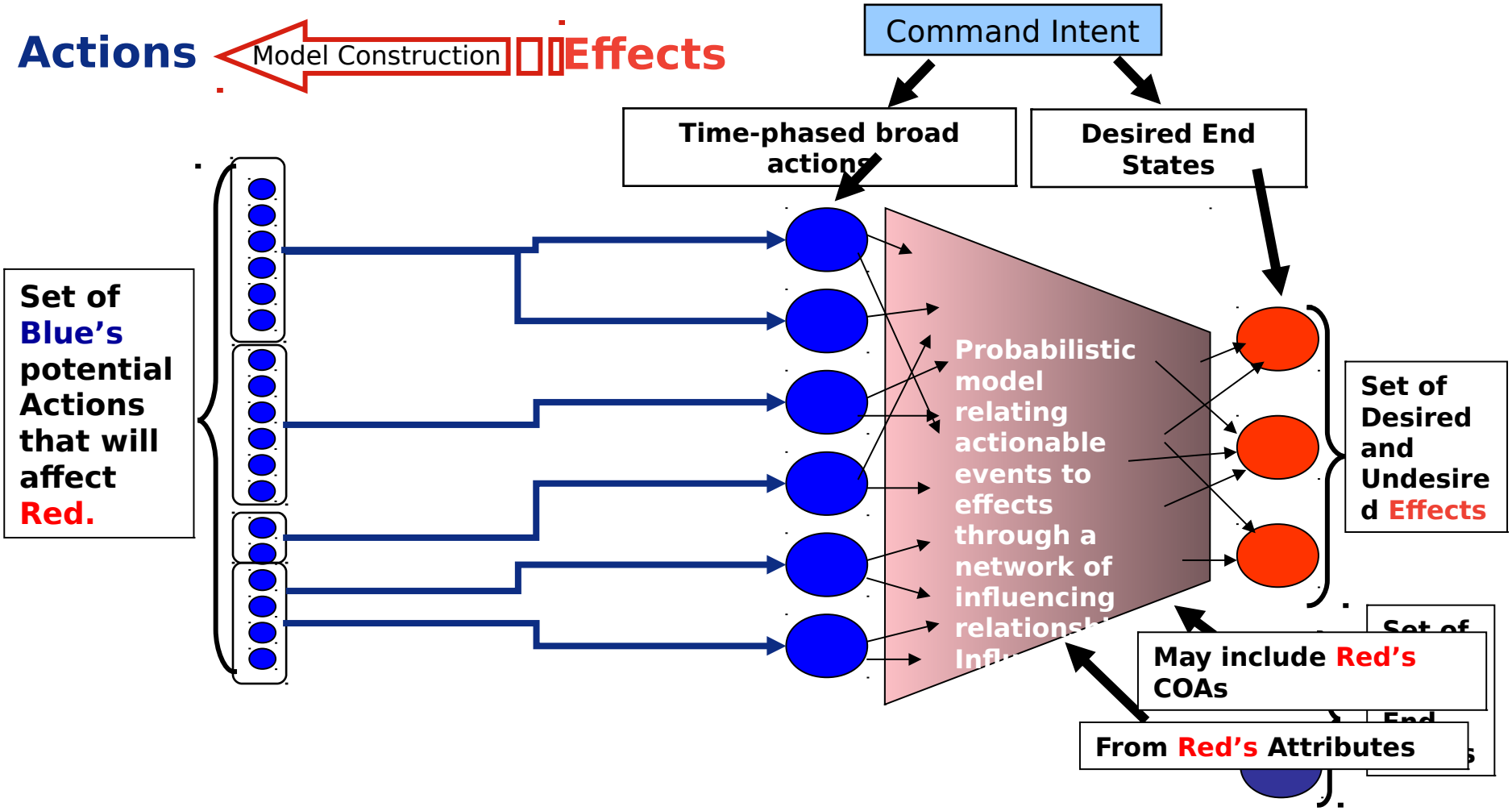


Effects Based Modeling for COA Development

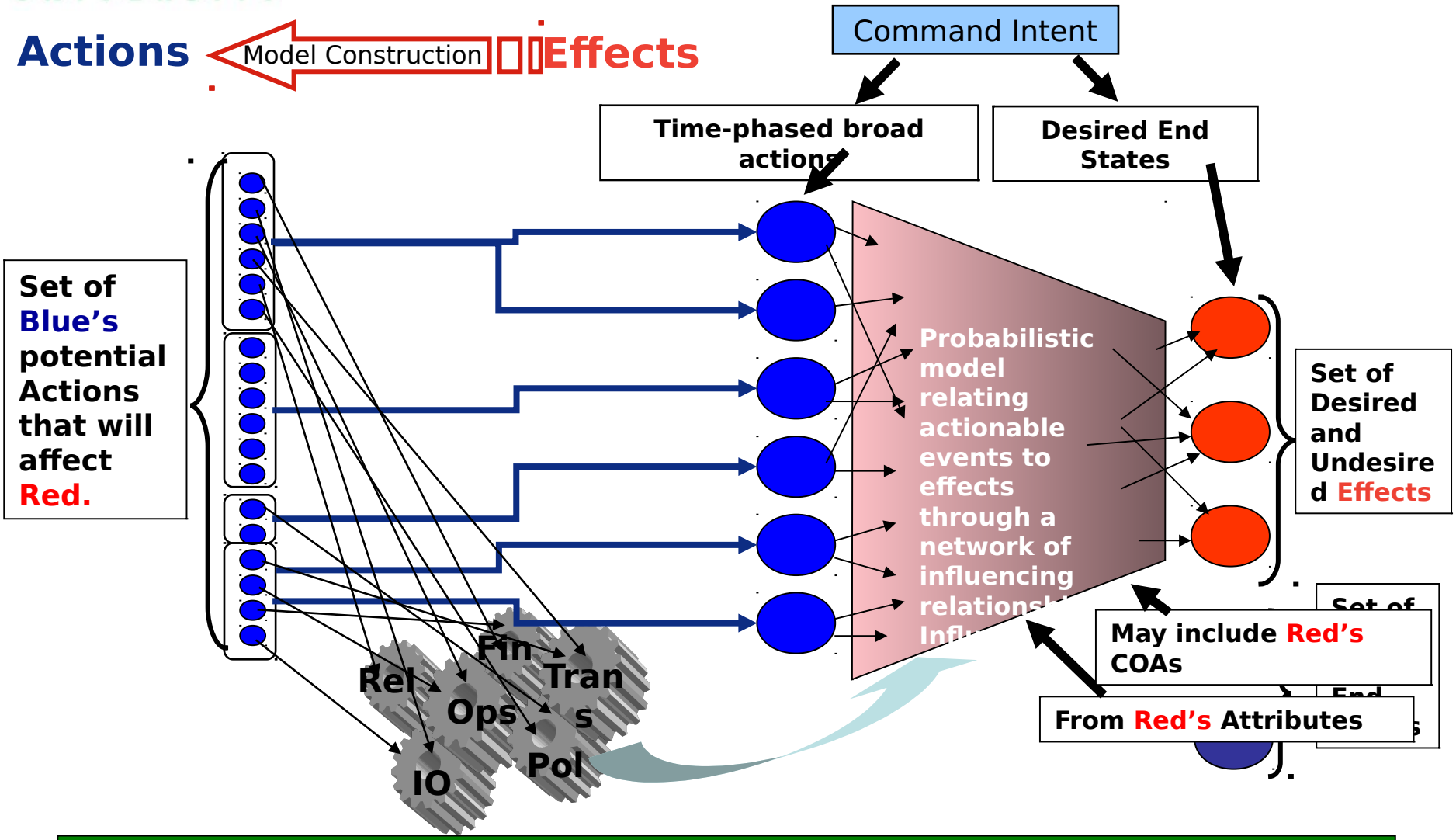
Actions ← Model Construction → **Effects**


Command Intent
Desired End States
Probabilistic model relating actionable events to effects through a network of influencing relationships of the adver
Set of Desired and Undesired Effects
May include Red's COAs
From Red's Attributes

Effects Based Modeling for COA Development


Actions
Model Construction
Effects
Command Intent
Time-phased broad actions
Desired End States
Set of Blue's potential Actions that will affect Red.
Probabilistic model relating actionable events to effects through a network of influencing
Set of Desired and Undesired Effects
May include Red's COAs
From Red's Attributes

Effects Based Modeling for COA Development



Effects Based Operations Modeling Approach

- **The Effects Based Operations modeling approach starts with the definition of desirable Effects on the Adversary (Red) and *the desired end state of Blue* (derived from commander's intent and guidance)**
- **Then we work backwards (from right to left) to the Centers of Gravity (COGs) of Red that influence the desired Effects – the arrows show the "Cause to Effect" relationships (left to right)**
- **Then we identify the Operational Functions of Red that affect the COGs, which in turn influence the Effect(s)**
- **We continue "unfolding" backwards in a "Effect to Cause" chain till we arrive at Actionable Events that can be carried out by Blue**
- **Finally, we include other external events, not controlled by Blue, that influence the achievement of the desired Effects on Red**
- **There are also "Cause to Effect" relationships that affect the *strength* of the influences (e.g., selected Information Operations)**

- **We are relating effects to objectives and actions to effects**

Summary

- **Two of the GMU models to be included in the test bed have been described**
- **The CMU models are described in Dr Carley's talk**
- **Individual models are already working**
- **Extensions of the current models are being carried out**
- **We are currently focusing on implementing the test bed so that we can conduct computational experiments that use multiple models**